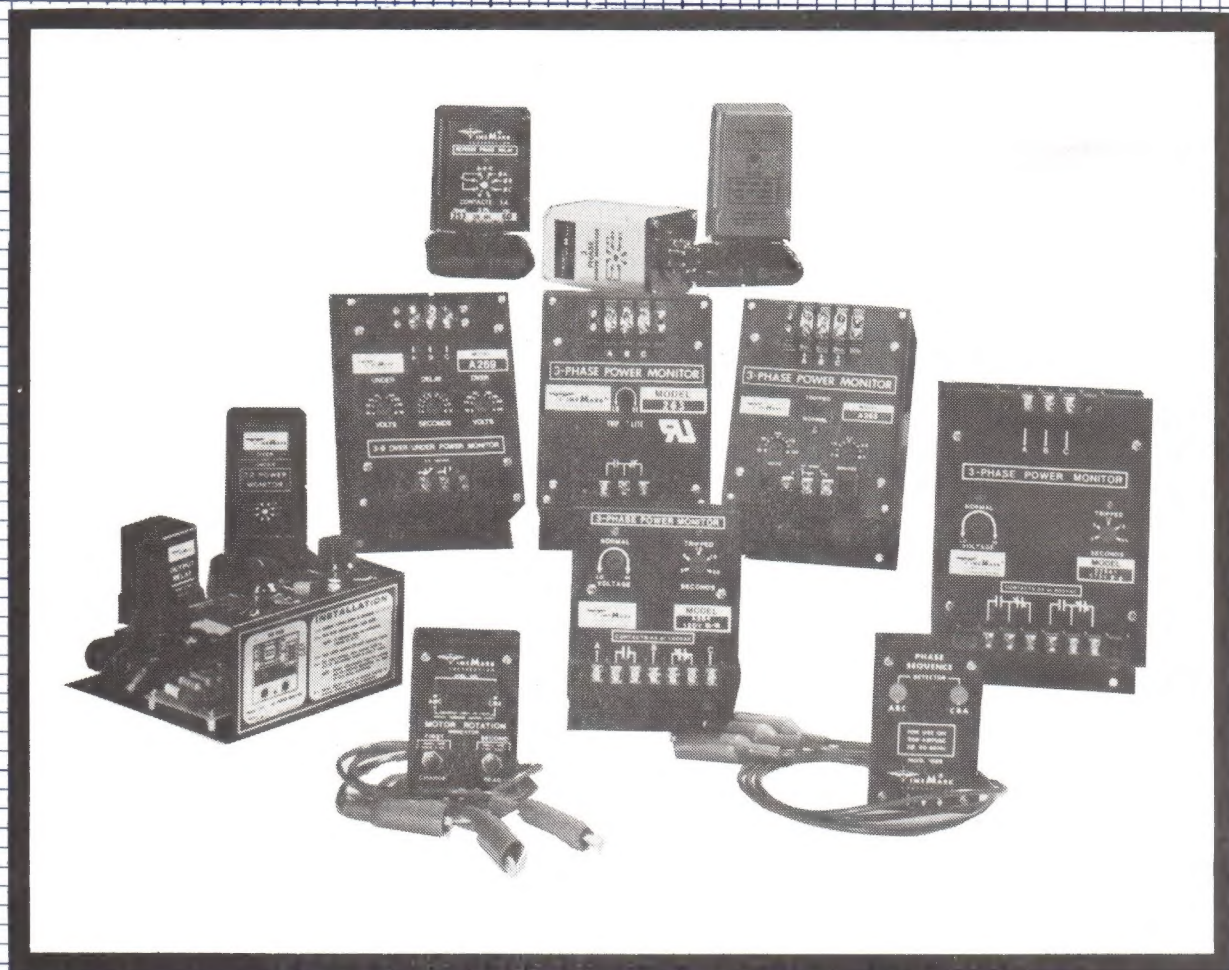


11440 E. PINE
TULSA, OK 74116
918 / 438 - 1220



**INDUSTRIAL
CONTROLS**

APPLICATION GUIDE



PHASE LOSS MONITORS

TABLE OF CONTENTS

General Notes.....	1
Phase Unbalance.....	1
Phase Loss.....	1
Phase Reversal.....	2
Models Available.....	2
Application.....	3
Elevator Protection Circuit.....	4
Manual Reset Alarm.....	4
Air Conditioning Systems.....	6
Water & Sewage Lift Station.....	7
Adjustment Procedures.....	8
Engineering Assistance.....	8
Models Available.....	Appendix A

LIST OF ILLUSTRATIONS

Figure 1 Schematic diagram (simplified)	1
Figure 2 Voltage readings at motor terminals with Phase 3 disconnected.....	2
Figure 3 Typical installation for 3 - phase monitoring.....	3
Figure 4 Typical installation - maximum protection	4
Figure 5 Phase loss sensing (manual reset).....	5
Figure 6 Phase loss sensing (manual reset).....	5
Figure 7 Sequential motor starting with phase loss sensing (auto reset)	6
Figure 8 Phase loss sensing (automatic reset)	6
Figure 9 Phase loss sensing for elevators (automatic reset).....	7
Figure 10 Alarm system requiring manual reset.....	7
Figure 11 Water & sewage lift station.....	8
Figure 12 Duplex pump control with phase loss sensing and solid- state alternator.....	8
Figure 13 Accurate method of adjustment for 3 - phase power monitors	8
Quick- Reference 3 - Phase Power Monitors.....	Appendix A

The information presented in this catalog is correct to the best of our knowledge . However , Time Mark Corporation does not warrant the applications as outlined nor make any offers that the circuits are free from patent infringement . Time Mark Corporation reserves the right to change or alter specifications at any time .

GENERAL

This application guide is written for use by equipment designers, maintenance personnel, electrical contractors, etc., to aid them in the installation of monitors to sense phase loss or phase unbalance for sensitive equipment. The application notes, charts and schematics are centered around several models of 3 - Phase Power Monitors manufactured by **Time Mark Corporation**. A simplified schematic diagram of the basic circuit and sensing method is shown in Figure 1.

The schematic shown in Figure 1 shows the basic circuit configuration used in all the 3 - Phase Power Monitors discussed in this application guide. The heart of the device is the exclusive "phase angle and voltage sensing network" developed by **Time Mark Corporation** which allows lost phases to be detected even when regenerative loads cause very little voltage decrease to be measured between phases.

PHASE UNBALANCE

Unbalance of a 3 - phase power system occurs when single phase loads are applied causing one or two of the lines to carry more or less of the load. On new installations of 3 - phase power

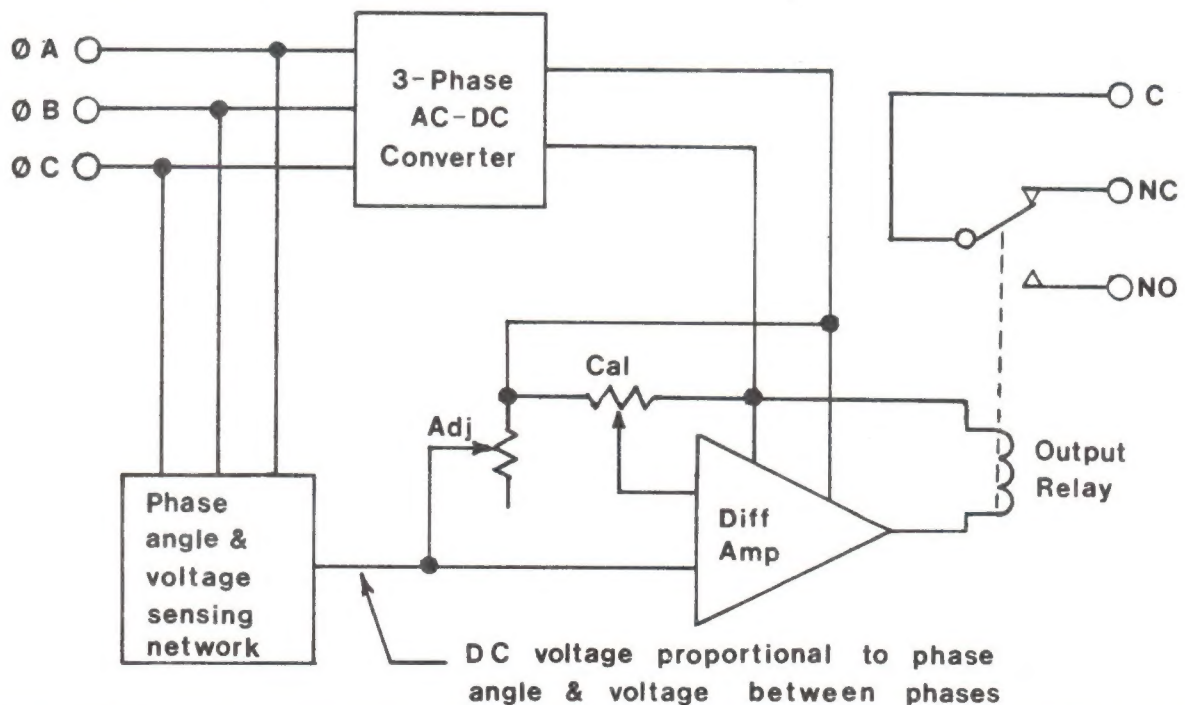
systems, careful attention is normally given to balancing of loads. However, as more and more single phase loads are added to the system, an unbalance begins to occur.

This phase voltage unbalance causes 3 - phase motors to run at temperatures greater than their published ratings. These high temperatures soon result in insulation breakdown and shortened motor life. Thermal overloads, magnetic breakers and other such devices usually will not detect this gradual unbalance and therefore do not afford proper protection.

PHASE LOSS

An extreme case of phase unbalance is the total loss of one of the three phases. This condition is generally known as "single phasing". The most serious result of this condition is that it can go undetected on most systems long enough to cause a motor failure. A 3 - phase motor running on single phase will continue to run, drawing all its current from two of the lines. In most cases, this condition will be undetectable by measuring the voltage at the motor terminals because the open winding in the motor is generating a voltage almost equal to the phase voltage that was lost (see chart in Figure 2). In this case, the phase angles will be displaced sufficiently to be detected by the **Time Mark** method.

FIGURE 1 Schematic diagram (simplified)



Phase loss can occur when a single phase overload condition causes a fuse to blow, by a 3 - phase circuit being struck by lightning, or by a mechanical failure within the switching equipment on machinery. Attempting to start a 3 - phase motor on a single phase will cause the motor to draw locked- rotor current. Thermal overloads are not always capable of preventing damage to the motor under these conditions.

Figure 2 shows voltage readings taken at the motor terminals on three different size induction motors and one synchronous type motor. The readings shown are with phase 3 disconnected and show the effect of the voltage being generated by the open motor winding under different load conditions.

It can be seen from the chart in Figure 2 that if a phase is lost and the normal line voltage varies from 420 volts to 480 volts that it would be impossible to detect the condition under all loads by sensing only voltages on the three lines. For this reason, phase angle detection in addition to voltage detection has been incorporated into the design of these power monitors. This method allows an additional 5 to 8% decrease in phase-to- phase voltage set- point. That is, to detect a lost phase on a 100 HP induction motor with no load, the line voltage would have to remain constant, and the detection point would have to be set at 95% of the line voltage. The addition of phase angle sensing allows the set- point to be

made at 85% to 90% so that normal line variations are not sensed as a failure or unbalance.

PHASE REVERSAL

Reversing any two of the three phases may cause damage to driven machinery or injury to personnel. This can occur when modifications are made to power distribution systems or when maintenance is performed on cabling and switching equipment. The National Electrical Code requires phase reversal detection on all equipment transporting people, such as elevators and escalators. **Time Mark 3 - Phase Power Monitors** are designed to sense a phase reversal condition under all load conditions.

MODELS AVAILABLE

The table in Appendix A gives some general information for use in selecting the device that best suits the application. The sensing method on all models shown are, for all practical purposes, the same. Variations in the models are in the type of enclosure, the wiring method, output relay contact rating, failure delays and adjustment ranges. More detailed information and specifications may be obtained by referring to individual data sheets available from the factory.

FIGURE 2 Voltage readings at motor terminals with Phase 3 disconnected

% LOAD	1 HP			10 HP			100 HP			2 HP (sync.)		
	1 - 2	2 - 3	3 - 1	1 - 2	2 - 3	3 - 1	1 - 2	2 - 3	3 - 1	1 - 2	2 - 3	3 - 1
0	480	402	434	480	432	443	480	446	451	480	405	431
25	480	401	422	480	439	438	480	454	438	480	404	420
50	480	399	405	480	430	437	480	459	429	480	401	404
75	480	394	376	480	426	430	480	453	410	480	397	382
100	480	391	364	480	410	416	480	440	325	480	392	371

APPLICATION

Figure 3 shows a typical application with a single motor load. Connecting the power monitor in this manner will allow sensing of any of the following:

1. Loss of primary fuse.
2. Loss of phase in secondary protection circuits.
3. Failure in primary or secondary windings of transformer.
4. Phase reversal throughout the distribution system.
5. Low voltage on feeder lines.

The power monitor may be connected as shown in Figure 3. This will allow installation without disturbing existing protection devices. Output contacts may be wired into a control circuit to trip the motor contactor should a failure occur, or to an audible alarm circuit, or to an automatic dialer.

Figure 4 shows a particular application of wiring a 3 - Phase Power Monitor between the starter and the motor. This wiring method offers maximum protection to the motor in the event of failure of the starter / contactor. However, when the bypass circuit includes a time delay relay it will allow the motor to start even if there is a low voltage condition, phase reversal, or phase loss for the time delay period. After the timer has timed - out, the 3 - Phase Power Monitor would sense the abnormal condition and drop - out the

motor. For other specific installation questions call the factory's Application Department.

Figures 5 and 6 show examples of how to install phase - loss / low voltage sensing, using the Model 258, where line transients might cause accidental or nuisance tripping. One cause of nuisance tripping is motor start - up; as a motor starts the voltage can dip considerably below nominal. Low cost solid - state time delay relays are used to delay the actual tripping of the main breaker motor starter contacts, allowing the motor to run to speed and the voltage to rise to nominal again. The amount of time delay may be adjusted to suit the application. The settings will vary with different installations but only in rare cases will the amount of delay exceed 10 seconds.

Figure 6 shows how to install phase - loss sensing when a typical motor starter is being used. Although the Model 258 responds within 50 milliseconds and trips, the Model 330 Time Delay Relay will allow the starter to remain energized until the 258 resets or the timer times out.

The previous diagrams illustrate a basic method of trip delay. However, several modes of **Time Mark 3 - Phase Monitors** have a time delay built into them. These would be wired as shown in Figure 3 and require no additional wiring to operate the trip delay. For other model information, refer to the Quick Reference Chart in Appendix A.

FIGURE 3 Typical installation for 3 - phase monitoring

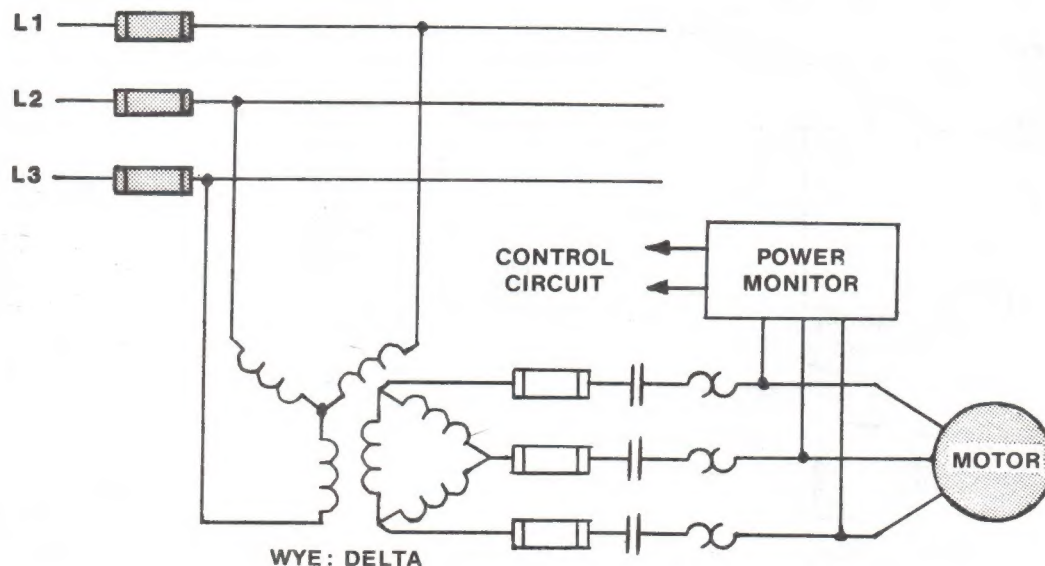


Figure 7 shows a method of monitoring against phase loss, low voltage or unbalance when a group of motors are being fed from a single transmission line. Starting all motors at once would cause a surge on the line which could cause properly rated fuses to blow. This sequential starting method will cause immediate shutdown if abnormal line conditions occur, and automatic sequential start-up at fixed intervals when the line conditions return to normal. **Time Mark** also manufactures a 6 Point Load Sequencer, the Model 352, which features a built-in time delay that is adjustable between 3 to 60 seconds.

Shunt trip circuit breakers are frequently used on main or feeder buses to disconnect power. These breakers require some form of AC power for their operation; that is, they have either a stored energy closing mechanism with an AC operated release coil or an AC solenoid operated closing mechanism. **Time Mark** manufactures two devices which store energy for shunt trip breakers, the Model 295 Capacitor Trip Device and the Model 410 Auto-Charged Capacitor Trip Device. A 3-Phase Power Monitor can be used as the control switch for a Capacitor Trip Device, monitoring for phase-loss, low voltage, or reverse phase conditions. Figure 8 shows one method of installing a **Time Mark** Model 259 and a Capacitor Trip Device.

ELEVATOR PROTECTION CIRCUIT

The 1981 National Electrical Code requires that elevators driven by polyphase AC motors be prevented from starting when there is a phase reversal or phase failure. The code also requires that hydraulic elevators driven by polyphase AC motors be designed to prevent overheating of the drive system by these conditions. Most interpretations of the code are to shut the elevator down if it is in operation or, occasionally, to allow it to run to the next landing before stopping. The diagram in Figure 9 illustrates a method of installing phase loss sensing in elevator controls. Loss of a phase will cause the 3-Phase Power Monitor to de-energize, but because the auxiliary relay is energized while the lift motor is running, the elevator will continue to run until it reaches the next landing.

MANUAL RESET ALARM

Each model of the power monitors is designed so that if an abnormal condition should appear on the line, its output relay would drop out. As soon as the abnormal condition is cleared, its output

FIGURE 4 Typical installation - maximum protection

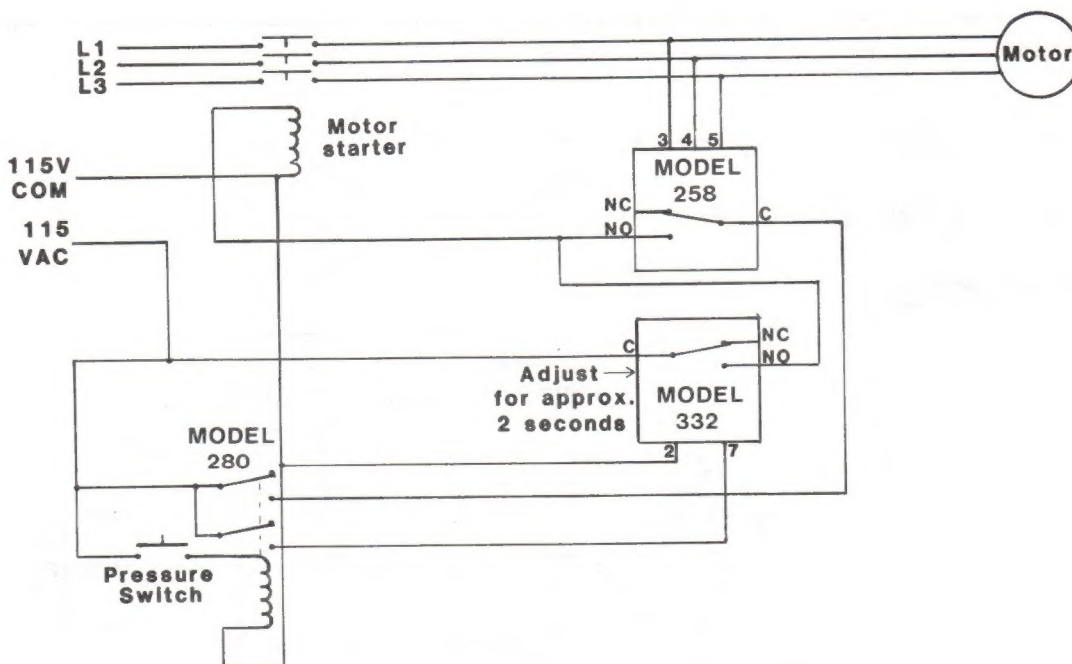


FIGURE 5 Phase loss sensing (manual reset)

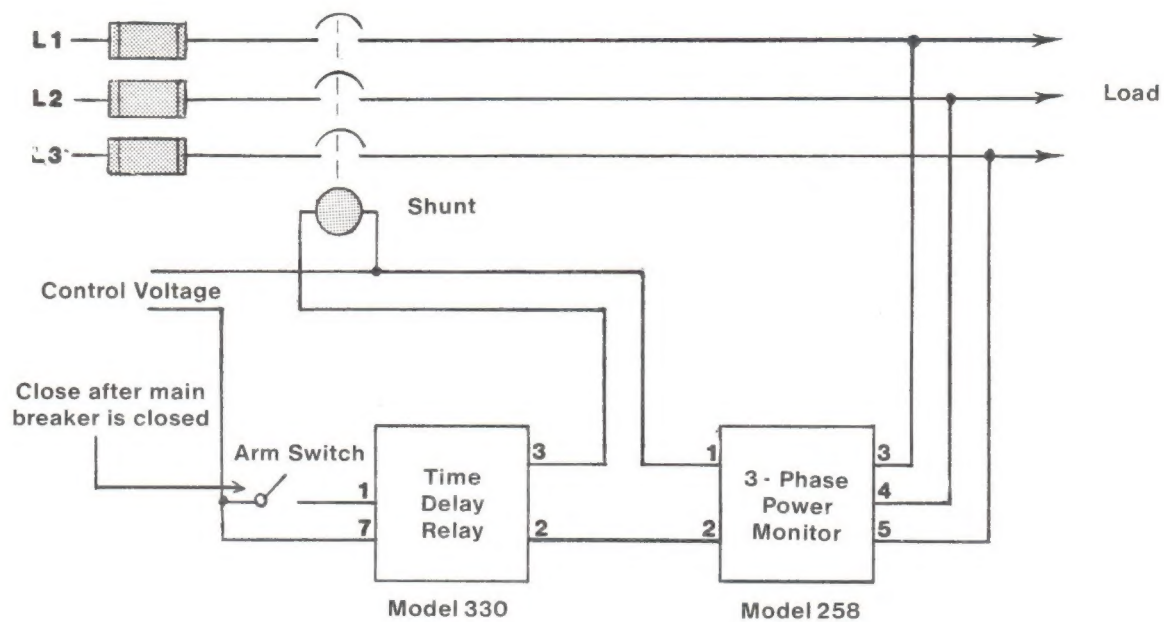
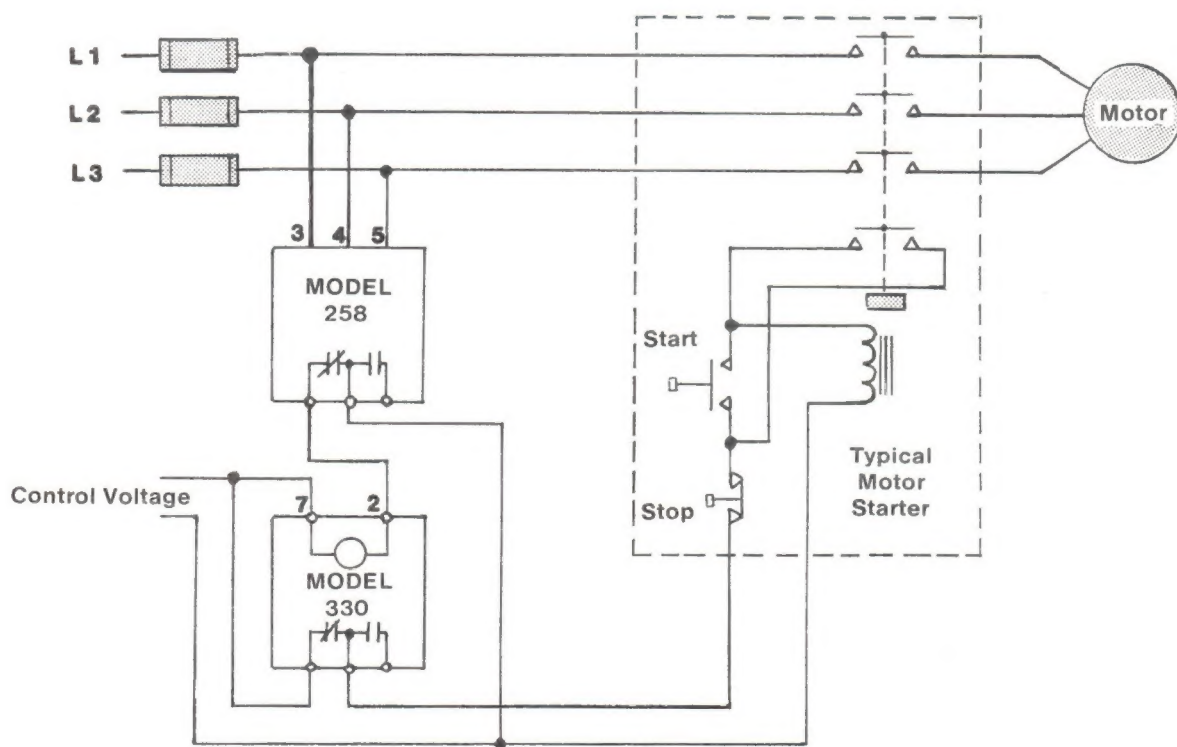


FIGURE 6 Phase loss sensing (manual reset)



relay would pull in again. This automatic resetting feature is desirable in most cases; however, there are applications where after sensing the abnormal condition, a "locked-out" condition is required, as in the case of alarms and annunciator systems. Figure 10 shows a simple method of achieving this locked-out condition requiring the system to be manually reset.

AIR CONDITIONING SYSTEMS

Phase loss and low voltage sensing for air conditioning systems is absolutely essential since compressor motors often run for long periods of time during summer months. An abnormal condition occurring on the 3-phase power lines should shut down the compressor motor immediately, but allow enough time for the head pressure to bleed off before restarting. Failure to allow time for this pressure to bleed off can cause the compressor motor to draw locked-

rotor current, resulting in damage to the motor or the opening of the other protective devices. The 258 or 263 Power monitor can be used along with a time delay relay to achieve this, but the 265 Power Monitor was developed to incorporate an adjustable restart delay in its design.

FIGURE 8 Phase loss sensing (automatic reset)

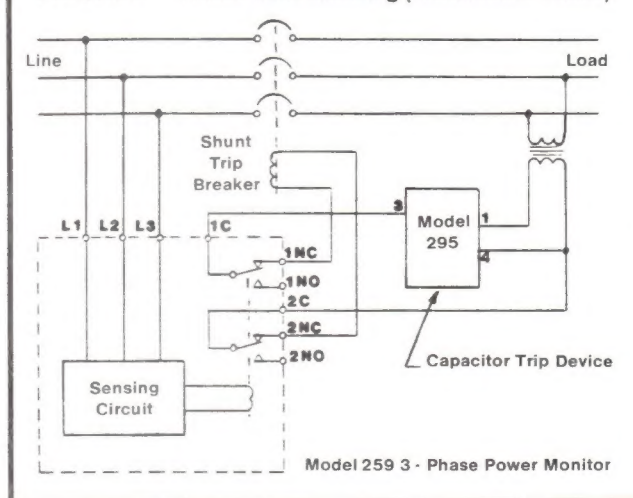
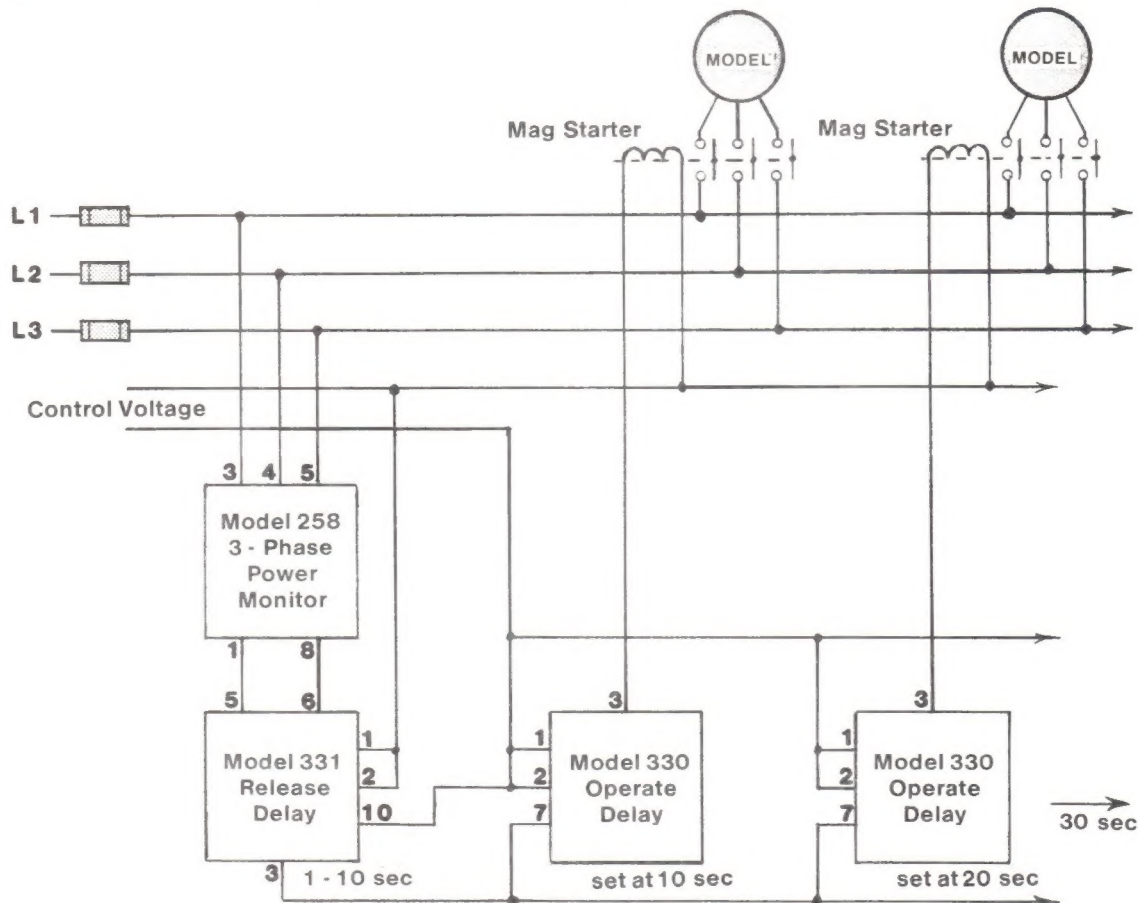


FIGURE 7 Sequential motor starting with phase loss sensing (auto reset)



WATER & SEWAGE LIFT STATION

The control of water levels is a continuous and demanding problem in many parts of the country and requires reliable equipment to prevent sewage back-ups, drainage system overflows, and consequently, pollution of our lakes and streams. The drawing in Figure 11 shows a typical sewage lift station and how liquid levels are monitored.

Control of the liquid level in the well is generally maintained by use of a duplex pump system as shown in Figure 12. Operation of the control

circuit depends on the use of float switches or other sensing devices suspended in the well. These switches tell the control circuit which pump to turn on and when both pumps are required. To keep one pump from being used more than the other, a solid-state alternating relay is used to alternately turn on one pump, then the other, as the liquid level moves between the "ONE PUMP RUNNING" switch and the "LOW LEVEL STOP" switch. If one pump cannot handle the volume and the level rises to the "BOTH PUMPS RUNNING" switch, both will come on and remain on until the level returns to the "LOW LEVEL STOP" position. A 3-Phase Power Monitor is incorporated to sense a lost phase/low voltage condition which could damage the pumps.

FIGURE 9 Phase loss sensing for elevators (automatic reset)

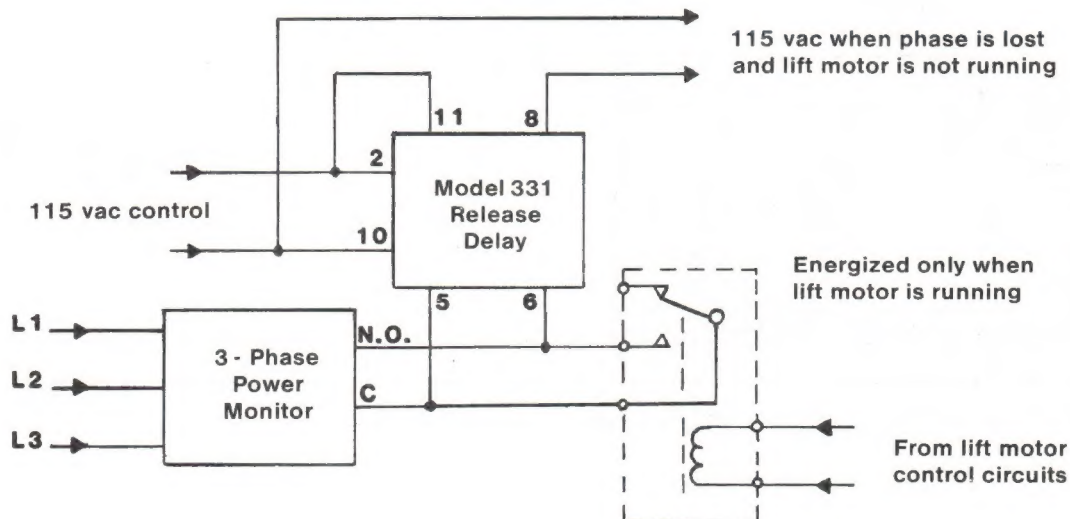
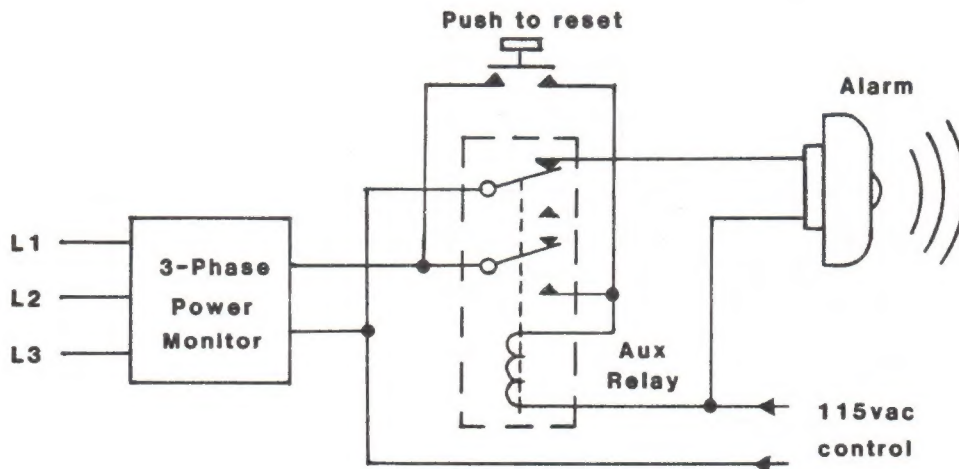


FIGURE 10 Alarm system requiring manual reset



ADJUSTMENT PROCEDURES

Adjustment of the drop-out point can be made by several methods. The simplest of these, and the one most commonly used, is to adjust the unit after it is installed but not yet connected into its interlock circuit. All models have indicator lights which make this adjustment very simple. First, determine the phase rotation. This can be done easily using the Model 108B Phase Rotation Indicator. Second, connect the 3 - phase

power to the proper terminals on the power monitor and adjust the failure level control so that the indicator is just "OUT". If the indicator will not go out, reverse any two of the three phases and readjust. If the adjustment described above is too sensitive and a lower drop-out setting is desired, Figure 13 shows an accurate adjustment method.

ENGINEERING ASSISTANCE

Time Mark Corporation maintains an applications group to aid you in any special application or special device you may require. There is no charge for this service.

FIGURE 11 Water & sewage lift station

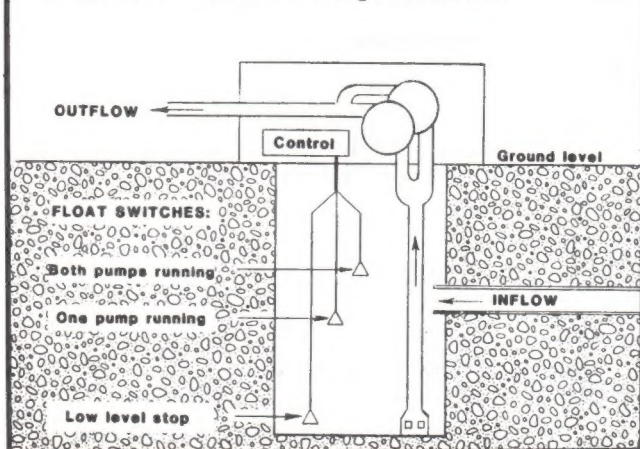


FIGURE 13 Accurate method of adjustment for 3 - phase power monitors

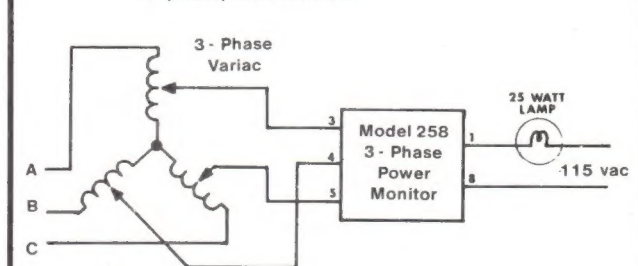
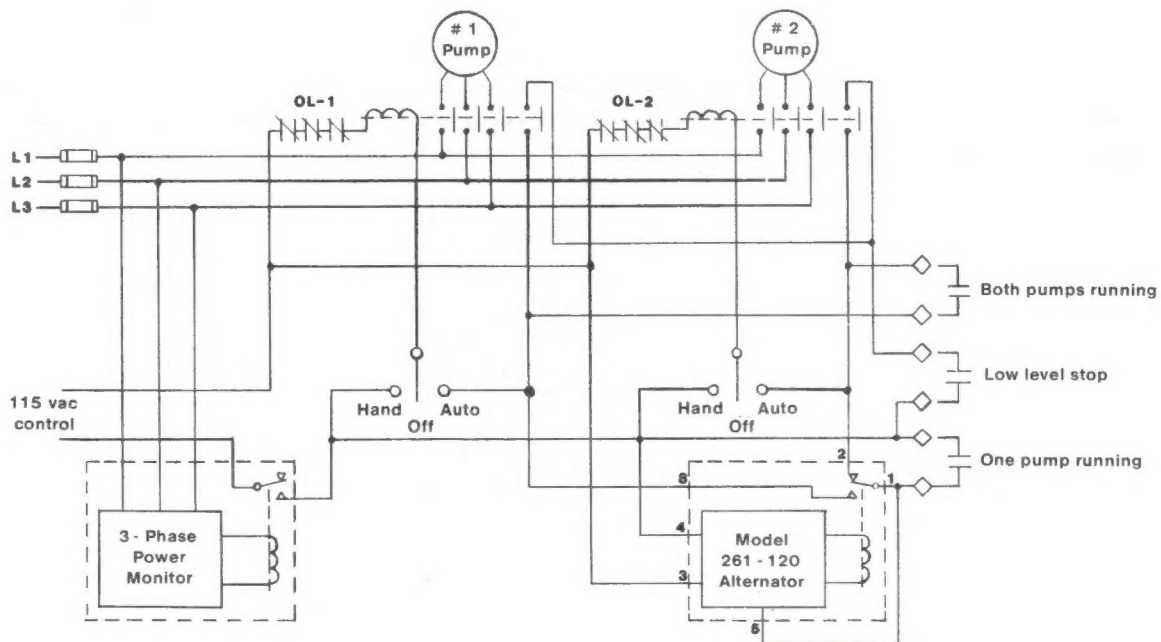


FIGURE 12 Duplex pump control with phase loss sensing and solid - state alternator



MODEL 246

Over & Under

3 - PHASE

POWER

MONITOR

RELAY DROPS OUT ON:

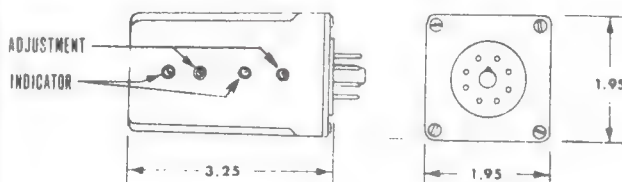
- Phase Loss
- Phase Reversal
- Low Voltage
- Over Voltage

AUTOMATIC RESET

DESCRIPTION

The Model 246 is designed to continuously monitor 3 - phase power lines for abnormal conditions. It features solid - state voltage and phase angle sensing circuits driving a SPDT electromechanical relay. A neutral is not required, allowing the 246 to be used with Wye or Delta systems. Versions cover the 120 and 240 VAC ranges, each adjustable throughout its operating range. LED indicators show failure condition and aid in adjustment and trouble shooting.

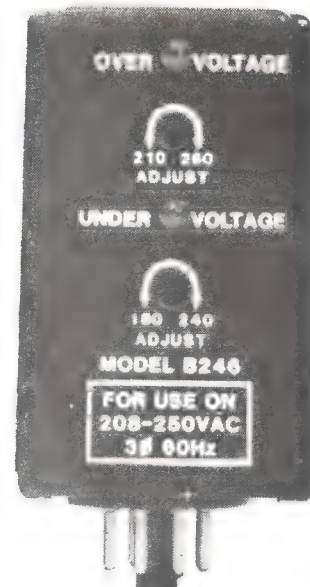
DIMENSIONS



ORDERING INFORMATION

Specify model number as shown at the top of the specifications section.

Special Voltage and frequency ranges available on request.



SPECIFICATIONS

MODEL A246 120V

Maximum Input Voltage..... 140 VAC, 60 Hz.

Adjustable Range..... High 110 - 140
Low 85 - 115

Repeat Accuracy (Fixed Conditions) 0.1%

Repeat Accuracy (0 - 60° C)..... 1.3%

Contact Rating 480 VA, 120 VAC

Response Time..... 0.05 Sec

Dead Band Between

Pull- In and Drop- Out..... 2%

Transient Protection... 2500 VRMS For 10 MS

MODEL B246 240V

Maximum Input Voltage..... 260 VAC, 60 Hz.

Adjustable Range..... High 210 - 260
Low 180 - 240

Repeat Accuracy (Fixed Conditions) 0.1%

Repeat Accuracy (0 - 60° C)..... 1.7%


Contact Rating 480 VA, 120 VAC

Response Time..... 0.05 Sec.

Dead Band Between

Pull- In and Drop- Out..... 2%

Transient Protection... 2500 VRMS For 10 MS

		11440 EAST PINE TULSA OKLAHOMA 74116 (918) 438 - 1220	
TITLE: MODEL 246 Over Under 3 - Phase		Unless Otherwise Specified Dimensions Are In Inches Drawings Show No Power Applied	
DRAWING NUMBER: 87 A 112		REVISION: A	
		SHEET 1 OF 1	

Model 269 3-PHASE OVER & UNDER POWER MONITOR

- Relay trips on:
 - Over voltage
 - Low voltage
 - Phase loss
 - Phase reversal
 - Phase unbalance
- Automatic reset

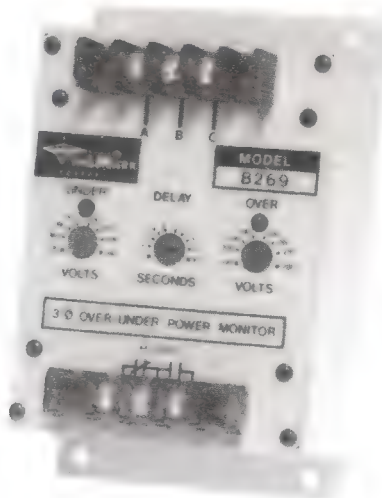
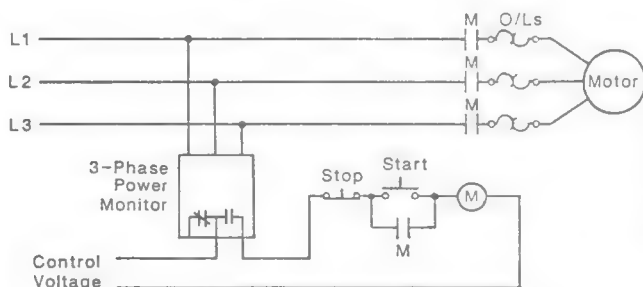
DESCRIPTION

The Model 269 Over & Under 3-Phase Power Monitor monitors 3-phase power lines for abnormal power conditions: low voltage, high voltage, phase loss (single phasing), phase reversal or phase unbalance.

The monitor features a solid-state voltage and phase angle sensing circuit driving a SPDT output relay. The 269 is independent of the system load and may be used on any horsepower rating motor. When phase sequence and balance are correct, and voltage remains between the lower and upper set-points, the output relay will remain energized. When a fault condition is sensed, the output relay will drop out. The Model 269 does not require a neutral connection and will operate on Delta or Wye systems. The monitor has an adjustable trip delay of 1 to 10 seconds to prevent nuisance tripping.

Three models cover 120, 240 or 480 VAC applications. Each can be adjusted throughout a wide operating range. Over and under voltage failure LED indicators aid in adjustment and system troubleshooting.

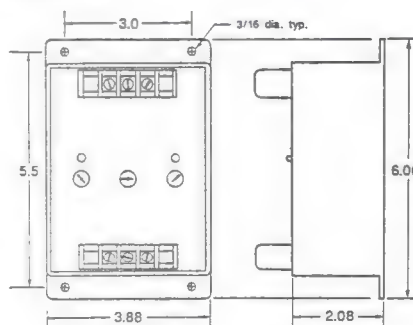
TYPICAL APPLICATION



SPECIFICATIONS

Model #	A269	B269	C269
Nominal voltage (phase-to-phase)	120 VAC	240 VAC	480 VAC
Max input voltage	165 VAC	300 VAC	560 VAC
Upper adjust range	110-145	210-280	400-540
Lower adjust range	80-115	170-240	380-460
Power consumption	1/2 W /phase	1 W /phase	2 W /phase
Repeat accuracy (0 - 60° C)	±1.3% max	±1.7% max	±2.1% max
Repeat accuracy (fixed conditions)	±0.1%		
Input frequency	60 Hz		
Effect of 50 Hz on calibrations	+ 10.3%		
Contact rating	4 amps at 115 VAC resistive 480 VA max at 240 VAC max		
Response time	Adjustable 1 - 10 seconds ± 5%		
Dead band	2% max.		
Transient protection	2500VRMS for 10ms		
Operating temperature	0 - 55° C		
Humidity tolerance	97% w/o condensation		
Case material	ABS plastic		
Weight	9 ounces max.		

DIMENSIONS



IME MARK®
CORPORATION

11440 EAST PINE
TULSA OKLAHOMA 74116
(800) 862-2875
in OK (918) 438-1220

TITLE MODEL 269
3-PHASE POWER MONITOR

Dimensions are in inches unless
otherwise specified. Drawings show
no power applied.

© TIME MARK CORP. 1987

FORM NO.

87A141

2/87

Model 257 3-PHASE POWER MONITOR

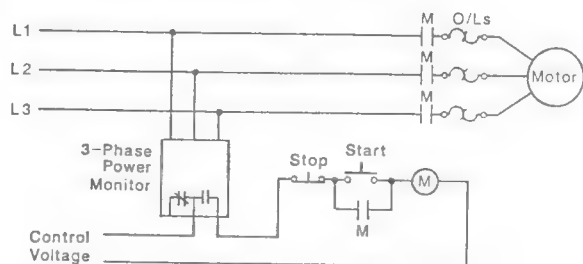
- Monitors phase loss, low voltage, phase reversal and phase unbalance
- Protect motors or other electrical equipment
- Socket mounted



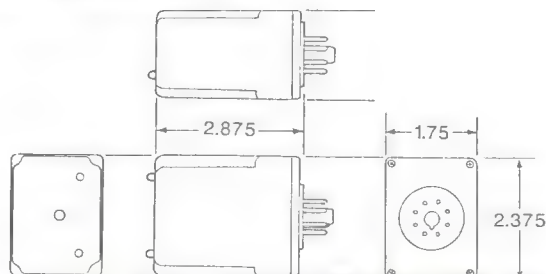
DESCRIPTION

The Model 257 series of 3-Phase Power Monitors are designed to continuously monitor 3-phase power lines for abnormal power conditions. The device consists of a solid-state voltage and phase-angle sensing circuit driving a SPDT electromechanical output relay. When correct voltage and phase sequence is applied the internal relay will energize. Low voltage, phase reversal, phase unbalance or phase loss will cause the relay to drop out. The monitor will detect a lost phase even if regenerated voltage is present. The 257 does not require a neutral connection, and can be used in either Wye or Delta configurations. Three adjustable-voltage models cover most applications from 120 to 480 VAC, 60 Hz. Special voltage and frequency versions are available from the factory. The adjustment and indicator lights are on top of the case for easy access and viewing after installation.

TYPICAL APPLICATION



DIMENSIONS



SPECIFICATIONS

Model number	B257B	257B	A257B
Nominal AC voltage (phase-to-phase)	120 VAC, 60 Hz	240 VAC, 60 Hz	480VAC, 60Hz
Max input voltage	140 VAC	260VAC	520 VAC
Adjustment range (VAC)	85 - 125	160 - 240	380 - 480
Power consumption	1/4 w/phase	1/2 w/phase	1 1/2 w/phase
Repeat accuracy (fixed conditions)	± 0.1%	± 0.1%	± 0.1%
Repeat accuracy (0 - 60° C)	± 1.3% max	± 1.7% max	± 2.1% max
Dead band	2% max		
Effect of 50 Hz on calibrations	+ 10.3%		
Response time	50 milliseconds		
Transient protection	2500 VRMS for 10ms		
Output contacts	SPDT		
Contact rating	5 amps at 120 VAC resistive		
Expected output relay life	Mechanical: 50,000,000 operations Electrical: 100,000 at rated load		
Operating temperature	-10 to 55° C		
Storage temperature	-20 to 70° C		
Operating humidity	0 - 97% w/o condensation		
Case	ABS plastic		
Mounting	8 pin screw terminal socket		
Weight	6 oz. max		

ORDERING INFORMATION

For standard versions, use the model numbers shown at the top of the specifications section. For factory-set versions, specify the trip voltage required. Consult the factory for other variations.



IME MARK®
CORPORATION

11440 EAST PINE
TULSA OKLAHOMA 74116
(800) 862-2875
in OK (918) 438-1220

TITLE MODEL 257 3-PHASE
POWER MONITOR

Dimensions are in inches unless
otherwise specified. Drawings show
no power applied.

© TIME MARK CORP. 1987

FORM NO

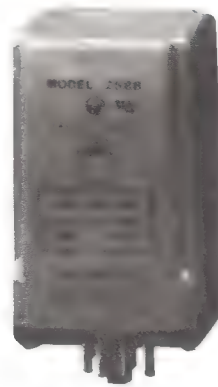
87A189

4/87

Model 258

3-PHASE POWER MONITOR

- Detects phase loss, phase reversal, low voltage and phase unbalance
- Plug-in convenience
- Automatic or optional manual reset

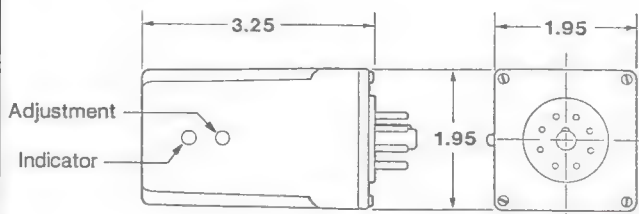


UL Recognized
File No. 60400

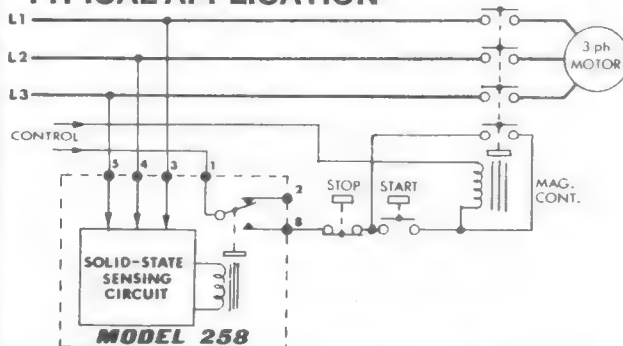
DESCRIPTION

The Model 258 continuously monitors 3-phase power lines for abnormal conditions. When properly adjusted, the Model 258 will detect phase loss on a loaded motor even when regenerated voltage is present. The device consists of a solid-state voltage and phase-angle sensing circuit driving an electromechanical relay. When correct voltage and phase rotation is applied the internal relay will energize. A fault condition will de-energize the relay; when the fault is corrected the 258 will automatically reset (a manual reset version is available). The 258 does not require a neutral connection and can be used with Wye or Delta systems. Three versions cover 120vac, 208/240vac and 480v AC, 60 Hz. Adjustment ranges are sufficiently wide to allow for proper adjustment to existing conditions. A failure indicator is provided to aid in adjustment and system troubleshooting. Special voltage and frequency ranges are available.

DIMENSIONS



TYPICAL APPLICATION



SPECIFICATIONS

Model No.	B258B	258B	A258B
Nominal voltage (phase-to-phase)	120vac	240vac	480vac
Adjustment range	85-125vac	160-240vac	380-480vac
Maximum voltage	140vac	260vac	520vac
Power consumption	1/4 W/phase	1/2 W/phase	1 1/2 W/phase
Frequency	60 Hz		
Effect of 50 Hz on calibrations	+ 10.3%		
Repeat accuracy (fixed conditions)	0.1%		
Dead band	2%		
Transient protection	2500 VRMS for 10ms		
Trip response	50 milliseconds		
Reset	Automatic (optional manual reset)		
Output contacts	SPDT		
Contact rating	480VA at 120vac		
Expected relay life	Mechanical: 50,000,000 operations Electrical: 100,000 at rated load		
Operating temperature	-10 to 55 deg. C		
Humidity tolerance	97% w/o condensation		
Case material	ABS plastic		
Weight	5 oz.		
Agency approval	120v and 240v models, auto reset, are UL Recognized		

ORDERING INFORMATION

For standard models, use the model numbers shown at the top of the specifications chart. Factory preset models, special voltage ranges, frequency ranges, manual reset or other minor variations are available. Consult the factory for pricing and availability.



11440 East Pine Street
Tulsa, Oklahoma 74116
(800) 862-2875
in OK (918) 438-1220
FAX (918) 437-7584

TITLE	3-Phase Power Monitor, Model 258	Dimensions are in inches unless otherwise specified. Drawings show no power applied.	
Copyr. 1988 Time Mark Corp.	FORM	87A123	1/88

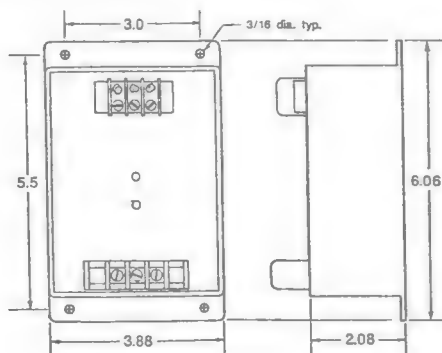
Model 263 3-PHASE POWER MONITOR

- Detects phase loss, low voltage, phase reversal, phase unbalance
- Automatic or manual reset

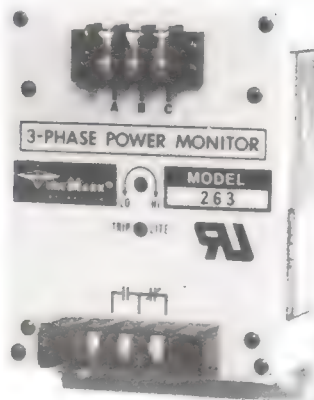
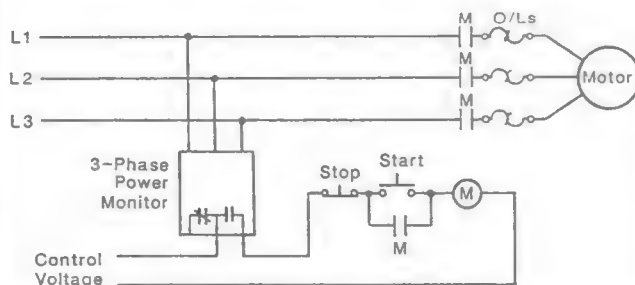
DESCRIPTION

The Model 263 3-Phase Power Monitor continuously monitors 3-phase lines for phase loss (even when regenerated voltage is present) and other abnormal conditions. The monitor consists of a solid-state voltage and phase-angle sensing circuit driving an electromechanical relay. Applying correct voltage and phase rotation will energize the relay; a fault condition will cause the relay to de-energize. When the fault is corrected the 263 will automatically reset (a manual reset version is available). The 263 does not require a neutral connection and can be used on Wye or Delta systems. Four voltage versions are available to cover 120, 240, 480 and 575vac, 60 Hz applications. Each is adjustable to allow the monitor to be set for existing conditions. A failure indicator is provided to aid in adjustment and system troubleshooting. Special voltage and frequency ranges are available on request.

DIMENSIONS



TYPICAL APPLICATION



UL Recognized
File No. 60400

SPECIFICATIONS

Model No.	A263	B263	C263	D263
Nominal voltage (phase-to-phase)	120vac	240vac	480vac	575vac
Adjustment range	85-125vac	160-240vac	380-480vac	420-575vac
Maximum input	140vac	280vac	520vac	600vac
Power consumption	1/4 W/phase	1/2 W/phase	1 1/2 W/phase	2 1/2 W/phase
Repeat accuracy (0-60 deg C)	1.3% max	1.7% max	2.1% max	2.5% max
Repeat accuracy (fixed conditions)	0.1%			
Input frequency	60 Hz			
Effect of 50 Hz on calibrations	± 10.3%			
Dead band	2%			
Transient protection	2500 VRMS for 10ms			
Trip response	50ms			
Output contacts	SPDT			
Contact rating	480 VA at 120vac			
Expected relay life	Mechanical: 50,000,000 operations Electrical: 100,000 at rated load			
Operating temp.	-10 to 55 deg. C			
Case material	ABS plastic			
Weight	9.5 oz.			
Agency approval	UL Recognized			

ORDERING INFORMATION

To order, specify the Model Number shown at the top of the specifications chart. For special versions, consult the factory.

Example: — 263 —
Voltage code — Blank - Automatic reset
M - Manual reset



11440 East Pine Street
Tulsa, Oklahoma 74116
(800) 882-2875
In OK (918) 438-1220
FAX (918) 437-7584

TITLE
3-Phase Power Monitor,
Model 263

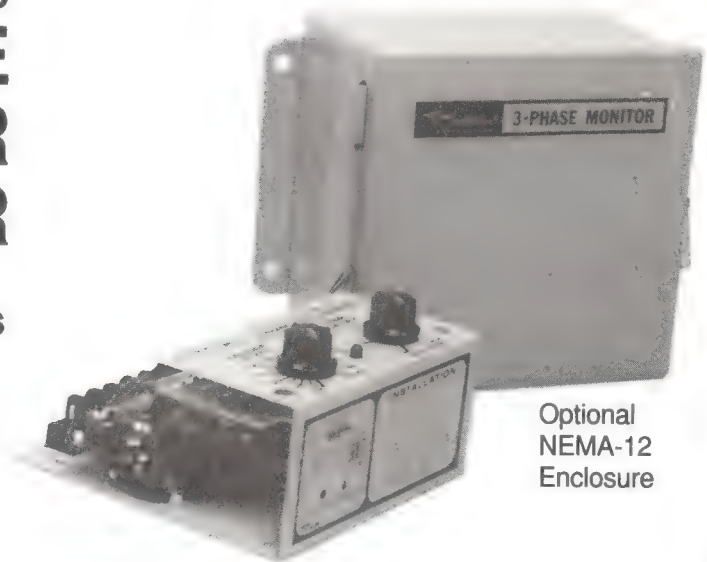
Dimensions are in inches unless
otherwise specified. Drawings show no
power applied.

Copyr. 1988 Time Mark Corp.

FORM 87A124 1/88

Model 259 3-PHASE POWER MONITOR

- DPDT 600 VAC output contacts
- Adjustable trip delay
- Adjustable failure level
- Automatic reset
- Optional enclosure

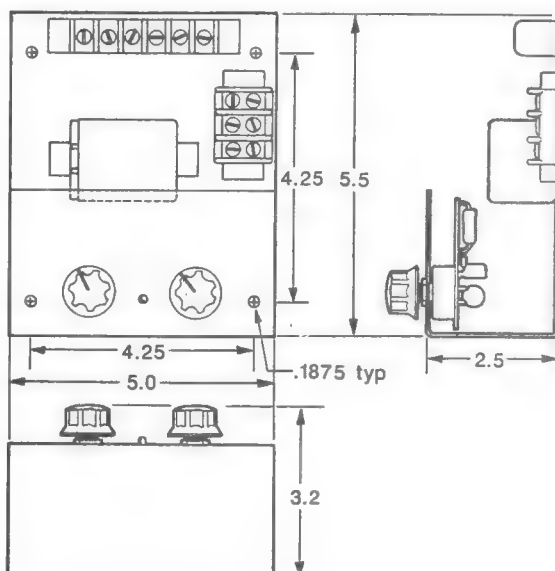


Optional
NEMA-12
Enclosure

DESCRIPTION

Model 259 Monitors may be used to protect individual 3-phase equipment and motors, or in conjunction with shunt trip breakers. When correct voltage and phase rotation is applied an internal DPDT relay energizes. A fault condition - phase loss, phase reversal, phase unbalance or low voltage - drops out the relay and lights the failure indicator. The monitor will detect a phase loss condition even when regenerative voltage is present. The Model 259 may be used with Wye or Delta systems and requires no neutral connection. Standard operating ranges are 120, 240, 480 or 575 VAC, 60 Hz. Consult the factory for special voltage, frequency or trip delay versions.

DIMENSIONS



SPECIFICATIONS

Model No.	A259	B259	C259	D259
Nominal AC voltage (phase - to - phase)	120 VAC	240 VAC	480 VAC	575 VAC
Max. input voltage	150 VAC	260 VAC	520 VAC	600 VAC
Adjust range (VAC)	85 - 125	160 - 240	340 - 480	420 - 575
Power consumption	2.1W	3.3W	4.2W	6.9W
Reverse phase protection (VAC)	0 - 150	0 - 240	0 - 520	0 - 600
Repeat accuracy (0 - 100° C)	1.1%	1.4%	1.7%	2.0%
Repeat accuracy (Fixed conditions)	0.1% max	0.1% max	0.1% max	0.1% max
Effect of phase angle displacement on trip setting	0.18 VAC/DEG	0.35 VAC/DEG	0.70 VAC/DEG	0.84 VAC/DEG
Expected life (hours)	210,000	210,000	121,000	109,000
Expected life	Mechanical: 10,000,000 operations Electrical: 100,000 @ rated load			
Transient protection	2500 VRMS for 10 ms			
Output contacts	DPDT			
Contact rating	3 amps at 480 / 600 VAC, 80% pf 10 amps at 240 VAC, 80% pf 1/2 HP at 240 / 480 / 600 VAC			
Operating temperature	-10 to 60° C			
Vibration tolerance	6 g, 10 - 55 Hz			
Humidity tolerance	0 - 97% w/o condensation			
Effect of 50 Hz on calibrations	+10.3%			
Weight	1.06 lbs.			



11440 EAST PINE
TULSA OKLAHOMA 74116
(800) 862-2875
in OK (918) 438-1220

TITLE MODEL 259 3-PHASE
POWER MONITOR

Dimensions are in inches unless
otherwise specified. Drawings show
no power applied.

© TIME MARK CORP. 1987

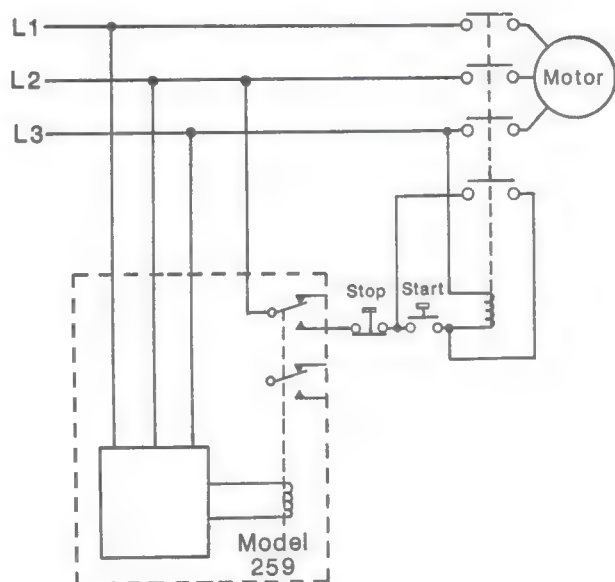
FORM NO.

87A116

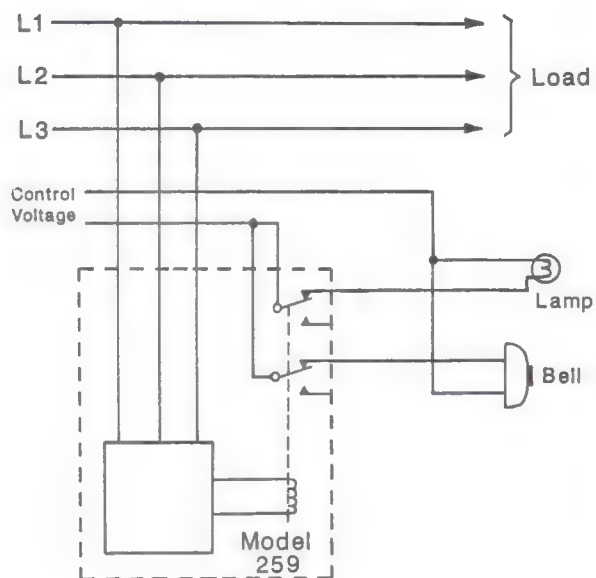
4/87

TYPICAL APPLICATIONS

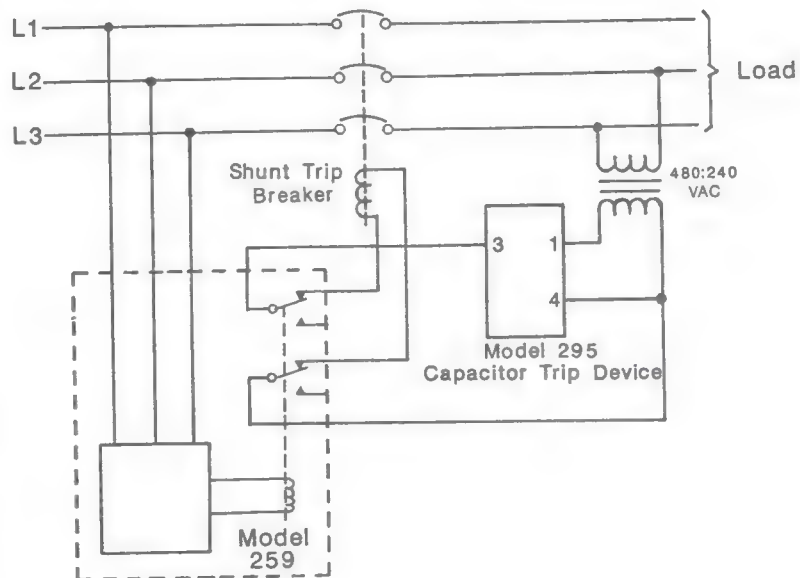
Individual Motor Protection



System Alarm

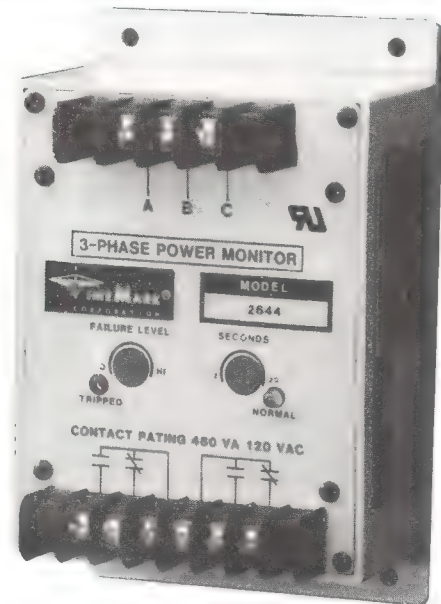


Operation of Shunt Trip Breaker



Model 2644 3-PHASE POWER MONITOR

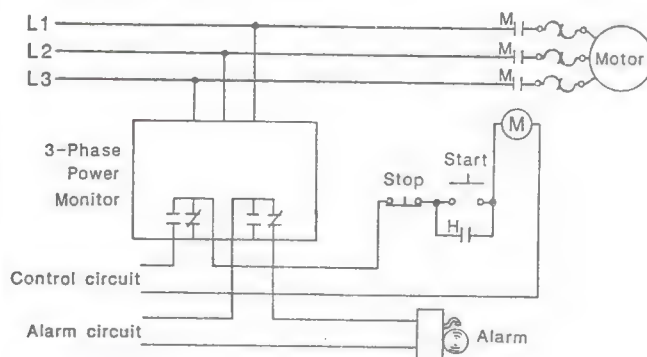
- Monitors phase loss, low voltage, phase reversal and phase unbalance
- Adjustable trip delay timer
- Automatic reset
- UL Recognized Component



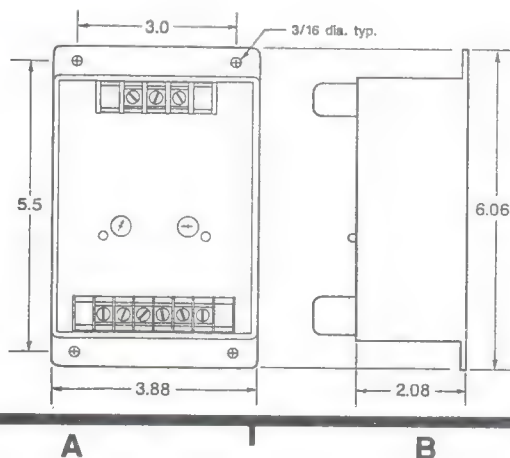
DESCRIPTION

The Model 2644 continuously monitors 3-phase Wye or Delta systems for abnormal conditions. The solid-state electronic circuitry drives two internal SPDT relays, allowing the 2644 to operate two motor control circuits or a control circuit and an alarm circuit. An adjustable trip delay reduces or eliminates nuisance tripping caused by momentary voltage fluctuations or motor startup. The Model 2644 is not sensitive to line current and can be used with any motor size.

TYPICAL APPLICATION



DIMENSIONS



SPECIFICATIONS

Model No.	A2644	B2644	C2644	D2644
Nominal AC voltage (phase to phase)	120VAC	240VAC	480VAC	575VAC
Adjustment range	90-125V	180-240V	360-480V	420-600V
Max input (60 Hz)	140V	260V	520V	600V
Power consumption (per phase)	.25 W	.5 W	1.5 W	2.5 W
Repeat accuracy (0-60° C)	1.3%	1.7%	2.1%	2.5%
Repeat accuracy (fixed conditions)	0.1%			
Effect of 50 Hz on calibrations	+10.3%			
Transient protection	2500VRMS for 10ms			
Output contacts	Two SPDT			
Contact rating	0.48KVA at 120 VAC			
Expected life	Mechanical: 50,000,000 operations Electrical: 100,000 at rated load			
Drop-out delay	0.2 to 20 seconds \pm 10%			
Operating temp.	0-70° C			
Humidity tolerance	97% w/o condensation			
Case material	ABS plastic			
Weight	11 oz.			



UL Recognized
File No. 60400



TIME MARK
CORPORATION

11440 EAST PINE
TULSA OKLAHOMA 74116
(800) 862-2875
in OK (918) 438-1220

TITLE MODEL 2644
3-PHASE POWER
MONITOR

Dimensions are in inches unless
otherwise specified. Drawings show
no power applied.

© TIME MARK CORP. 1987

FORM NO.

87A146

7/87

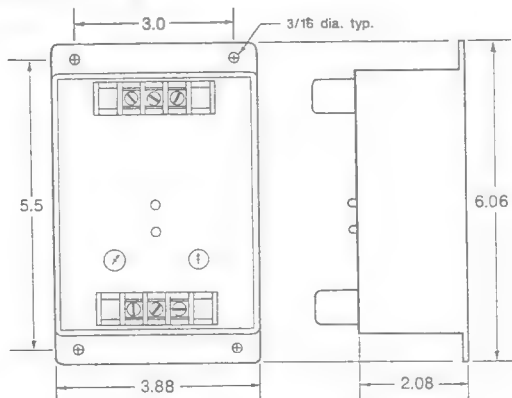
Model 265 3-PHASE POWER MONITOR

- Adjustable restart delay
- Ideal for HVAC or air compressor applications
- Fast trip response

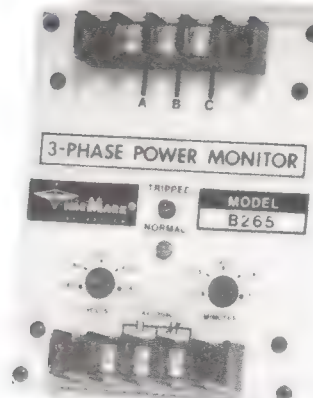
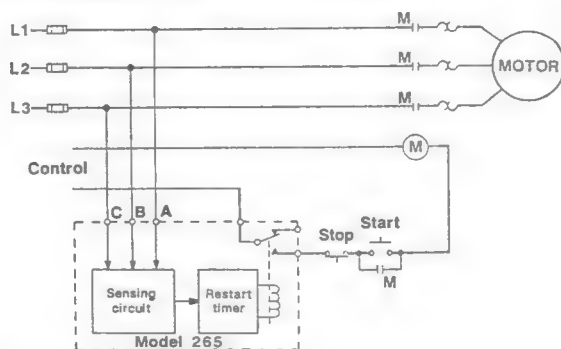
DESCRIPTION

The Model 265 continuously monitors 3-phase Wye or Delta systems for phase loss, low voltage, phase reversal and phase unbalance. The solid-state sensing circuits drive an internal relay in a fail-safe configuration (relay energized when correct voltage and phasing are applied). Operating power is drawn from the 3-phase line being monitored. An adjustable reset timer delays restarting of the load, allowing up to five minutes for compressor head pressures to bleed off in the event of short-term power failures. The Model 265 is not sensitive to line current and can be used with any motor size.

DIMENSIONS




TYPICAL APPLICATION



SPECIFICATIONS

Model No.	A265	B265	C265	D265
Nominal AC voltage (phase to phase)	120VAC	240VAC	480VAC	575VAC
Adjustment range	85-125V	160-255V	340-500V	420-600V
Max input (60 Hz)	140V	260V	520V	620V
Power consumption (per phase)	.25 W	.5 W	1.5 W	2.5 W
Repeat accuracy (fixed conditions)	0.1%			
Effect of 50 Hz on calibrations	+10.3%			
Transient protection	2500VRMS for 10ms			
Contact rating	4 amps at 115VAC resistive 2 amps at 230VAC resistive			
Expected life	Mechanical: 50,000,000 operations Electrical: 100,000 at rated load			
Drop-out time	0.05 seconds			
Reset delay	0.3 to 300 seconds			
Dead band	2%			
Operating temp.	0-55° C			
Humidity tolerance	97% w/o condensation			
Case material	ABS plastic			
Weight	10 oz.			



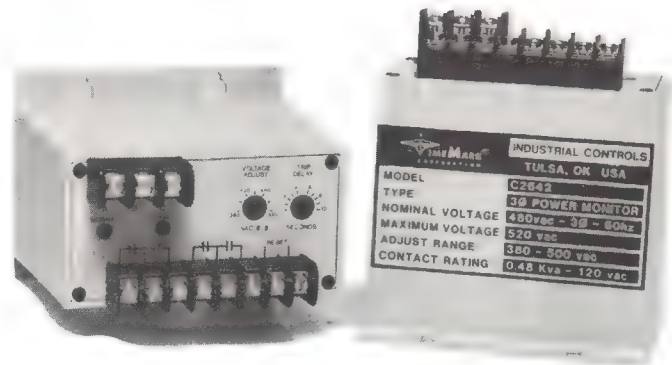
TIME MARK
CORPORATION

11440 EAST PINE
TULSA OKLAHOMA 74116
(800) 862-2875
in OK (918) 438-1220

<p>TITLE MODEL 265 3-PHASE POWER MONITOR</p>	<p>Dimensions are in inches unless otherwise specified. Drawings show no power applied.</p>
<p>© TIME MARK CORP. 1987</p>	<p>FORM NO. 87A128 7/87</p>

Model 2642 3-PHASE POWER MONITOR

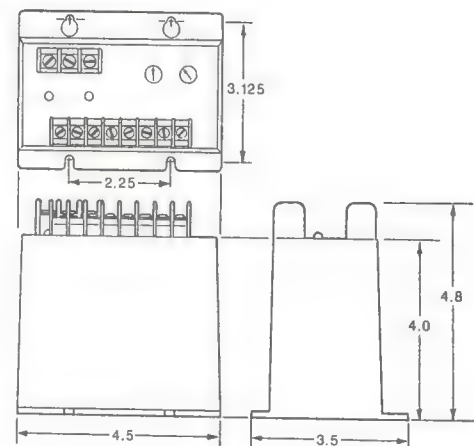
- Monitors phase loss, low voltage, phase reversal and phase unbalance
- Adjustable trip delay
- Automatic or manual reset
- DPDT output contacts



DESCRIPTION

The Model 2642 3-Phase Power Monitor is designed to protect electrical equipment by sensing phase loss, low voltage, reverse phase and unbalanced phases. The monitor uses a combination of voltage and phase angle sensing, and will detect a phase loss even when regenerated voltages are present. The Model 2642 is failsafe; the output contacts will transfer when correct power is applied, and drop out on any fault condition or loss of power. Each voltage version can be adjusted throughout a wide operating range. An adjustable trip delay timer prevents nuisance tripping caused by momentary voltage dips. LED indicators show 'Normal' (green) and 'Trip' (red) status. The monitor has an automatic reset which can be converted to manual reset with the addition of a normally closed switch. The DPDT output can be used in motor control circuits and/or alarm circuits.

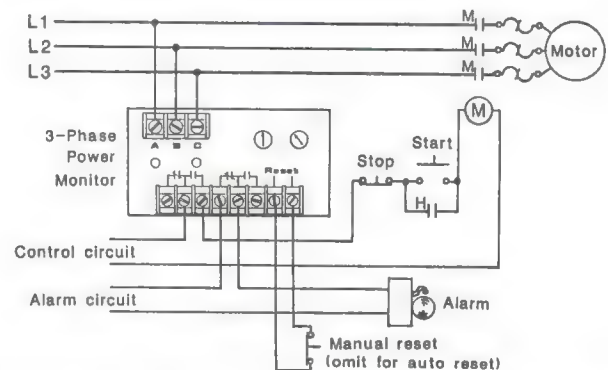
DIMENSIONS



SPECIFICATIONS

Model No.	A2642	B2642	C2642	D2642
Nominal voltages (phase to phase)	120 VAC	240 VAC	480 VAC	575 VAC
Adjustment range (VAC)	90-120	180-240	380-500	460-580
Maximum voltage (VAC)	140	260	520	600
Input frequency	60 Hz			
Effect of 50 Hz on calibrations	+ 10.3%			
Repeat accuracy (fixed conditions)	± 0.5% of set point			
Repeat accuracy (0 to 60 deg C)	± 2% of set point			
Dead band	2% max			
Reset	Selectable automatic or manual			
Trip delay	Adjustable 1 to 10 seconds ± 5%			
Output contacts	DPDT			
Contact rating	Resistive: 4 amps @ 120 VAC max Inductive: 480 VA @ 120 VAC			
Expected life	Mechanical: 50,000,000 operations Electrical: 100,000 @ rated load			
Operating temp.	-10 to 55° C			
Storage temp.	-20 to 70° C			
Humidity tolerance	97% w/o condensation			
Case	ABS plastic			
Weight	12 oz.			

TYPICAL APPLICATION



11440 EAST PINE
TULSA OKLAHOMA 74116
(800) 862-2875
in OK (918) 438-1220

TITLE
MODEL 2642
3-PHASE POWER MONITOR

Dimensions are in inches unless
otherwise specified. Drawings show
no power applied.

© TIME MARK CORP 1986

FORM NO. 87A169 8/87

Model 2652 3-PHASE POWER MONITOR

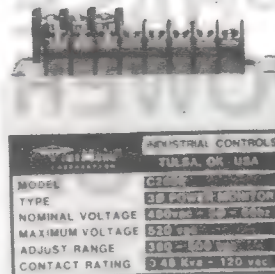
- Monitors phase loss, low voltage, phase reversal and phase unbalance
- Adjustable trip and restart delay
- Automatic or manual reset
- DPDT output contacts

DESCRIPTION

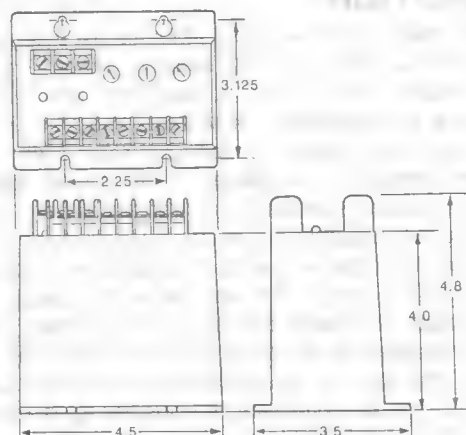
The Model 2652 is designed to protect motors, pumps, HVAC and air compressors, or other 3-phase equipment by sensing phase loss, low voltage, phase reversal and phase unbalance. The double pole, double throw (DPDT) output contacts will transfer when correct power is applied, and will drop out when a fault condition or loss of power occurs. An adjustable trip delay prevents nuisance trips and a restart delay timer prevents short cycling (primarily for HVAC and compressor motors). Each voltage version of the 2652 can be adjusted throughout a wide operating range. The unit is housed in a surface mounted, ABS plastic, machine tool case to reduce panel space requirements. DPDT output contacts allow the 2652 to be used in control circuits and/or alarm circuits. The Model 2652 has an automatic reset which can be converted to a manual reset by adding a normally closed switch.

SPECIFICATIONS

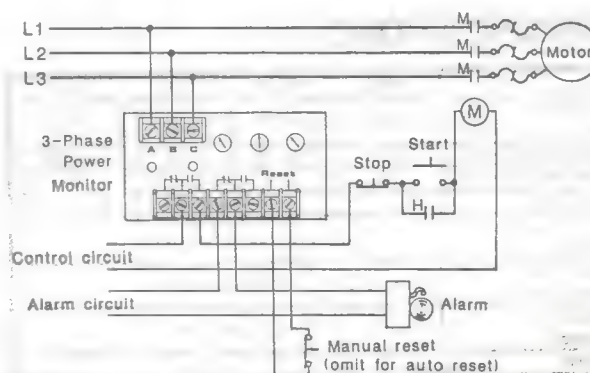
Model No	A2652	B2652	C2652	D2652
Nominal voltages (phase to phase)	120 VAC	240 VAC	480 VAC	575 VAC
Adjustment range (VAC)	90-120	180-240	380-500	460-580
Maximum voltage (VAC)	140	260	520	600
Input frequency	60 Hz			
Effect of 50 Hz on calibrations	± 0.3%			
Repeat accuracy (fixed conditions)	± 0.5% of set point			
Repeat accuracy (0 to 60 deg C)	± 2% of set point			
Dead band	2% max			
Reset	Selectable automatic or manual			
Trip delay	Adjustable 1 to 10 seconds ± 5%			
Restart delay	Adjustable 0.3 to 5 minutes ± 5%			
Output contacts	DPDT			
Contact rating	Resistive 4 amps @ 120 VAC max Inductive 480 VA @ 120 VAC Mechanical 50,000 operations Electrical 100,000 @ rated load			
Expected life				
Operating temp	-10 to 55°C			
Storage temp	-20 to 70°C			
Humidity tolerance	97% w.o. condensation			
Case	ABS plastic			
Weight	12 oz			




DIMENSIONS



TYPICAL APPLICATION





IME MARK CORPORATION

11440 EAST PINE
TULSA, OKLAHOMA 74116
(800) 862-2875
in OK (918) 438-1220

<p>TITLE MODEL 2652 3-PHASE POWER MONITOR</p>	<p>Dimensions are in inches unless otherwise specified. Drawings show no power applied.</p>
<p>© TIME MARK CORP 1986</p>	<p>FORM NO. 87A170 8/87</p>

Model 2532 REVERSE PHASE RELAY

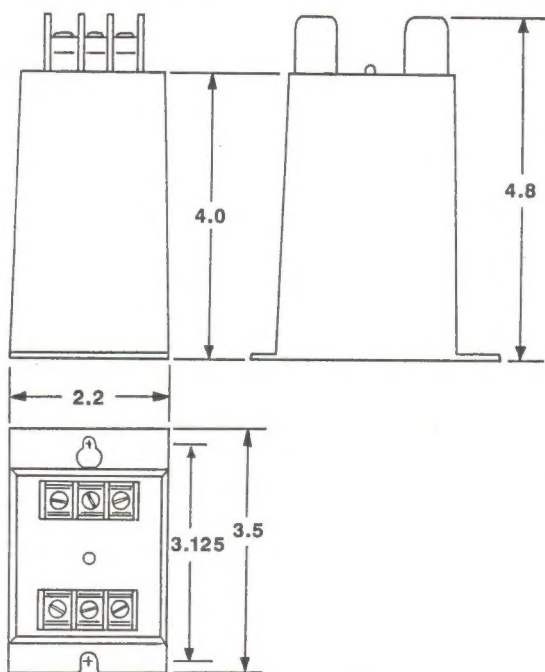
- Senses phase reversal on Wye or Delta systems
 - Operates from 208 to 480 VAC
 - Machine tool case
 - UL Recognized
- Component file no. 60400



DESCRIPTION

The Model 2532 Reverse Phase Relay is designed to continuously monitor phase rotation of 3-phase lines. The device is used in applications where proper phase rotation is critical, such as fan motors, compressors, grinders, elevators, etc. A solid-state electronic circuit drives an internal electromechanical relay which energizes on application of correct phase rotation power. The relay will de-energize when any two phases become reversed, even while the motor is running. An LED indicator will light on correct A-B-C rotation. The 2532 is a UL Recognized Component.

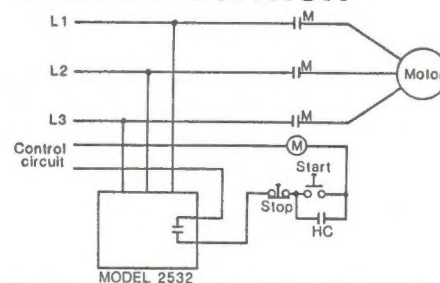
DIMENSIONS



SPECIFICATIONS

Operating range (phase-to-phase)	190-500 VAC
Maximum input voltage	540 VAC
Operating frequency	60 HZ
Effect of 50 Hz on calibrations	+10.3%
Transient protection	2500 VRMS for 10ms
Response time	0.05 seconds
Reset	Automatic
Operating temperature	-10 to 55° C
Humidity tolerance	97% w/o condensation
Contacts	SPDT
Contact rating	480 VA at 120 VAC (240 VAC max)
Expected relay life:	
Mechanical	50,000,000 operations
Electrical	100,000 at rated load
Case	ABS plastic
Weight	7 oz max

TYPICAL APPLICATION



11440 EAST PINE
TULSA OKLAHOMA 74116
(800) 862-2875
in OK (918) 438-1220

TITLE MODEL 2532
REVERSE PHASE RELAY

Dimensions are in inches unless
otherwise specified. Drawings show
no power applied.

© TIME MARK CORP. 1987

FORM NO.

87A149

8/87

A

B

C

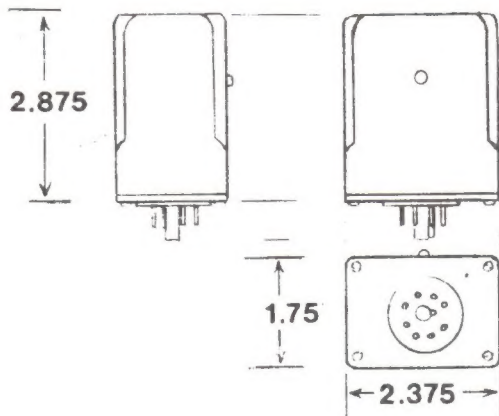
D

MODEL 253

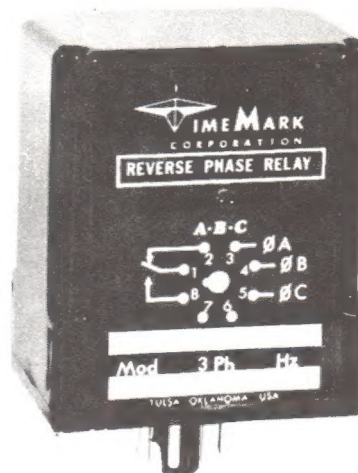
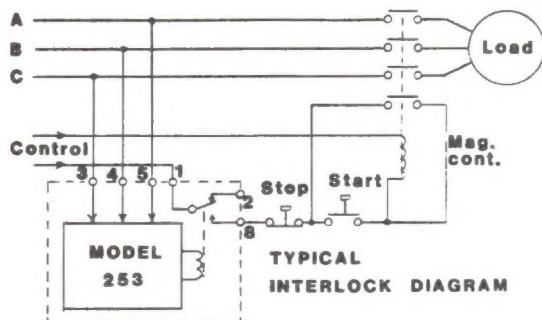
REVERSE PHASE RELAY

- Easily Socket Mounted
- Eliminates Phase Reversal
- Industrial Grade Relay For Low Power Consumption

DIMENSIONS



SIMPLIFIED DIAGRAM



DESCRIPTION

The Model 253 Reverse Phase Relay is a solid state sensing device designed for installation in equipment using 3 - phase power. This unit is used where it is desirable to have a contact closure indicating the proper phase rotation sequence has been applied. The relay closes when the ABC sequence is properly applied and will remain open if any two phases are reversed. This model has a special industrial grade relay designed for low power consumption. The ABC indicator will be illuminated when the proper phase rotation sequence is applied.

SPECIFICATIONS

Operating Range 208 - 480
 Extreme Limits..... 190 - 500
 Mounting 8 - Pin Relay Base
 (Not Supplied)
 Frequency..... 50 to 60 Hz.
 Reset Automatic
 Operating Temperature..... - 20 to 130° F
 Transient Protection..... 2500 V for 10 M Sec.
 Contact Rating..... 480 VA, 4 Amps Max.
 240 VAC Max.



IME MARK
CORPORATION

11440 EAST PINE
TULSA OKLAHOMA 74116
(918) 438-1220

TITLE: MODEL 253
Reverse Phase Relay

Unless Otherwise Specified
Dimensions Are In Inches
Drawings Show No Power Applied

DRAWING NUMBER: 87 A 113

REVISION: A

SHEET 1 OF 1

A

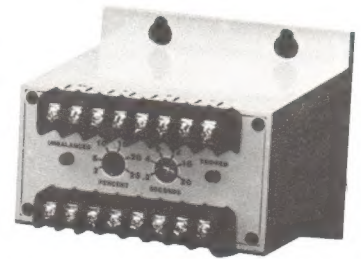
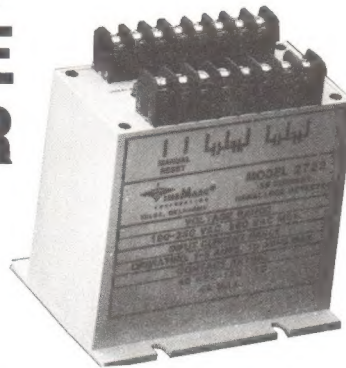
B

C

D

Model 2722 CURRENT UNBALANCE DETECTOR

- Works on 3-phase, or three single-phase motors
- Detect open 3-phase heating elements



UL Recognized
File No. 60400

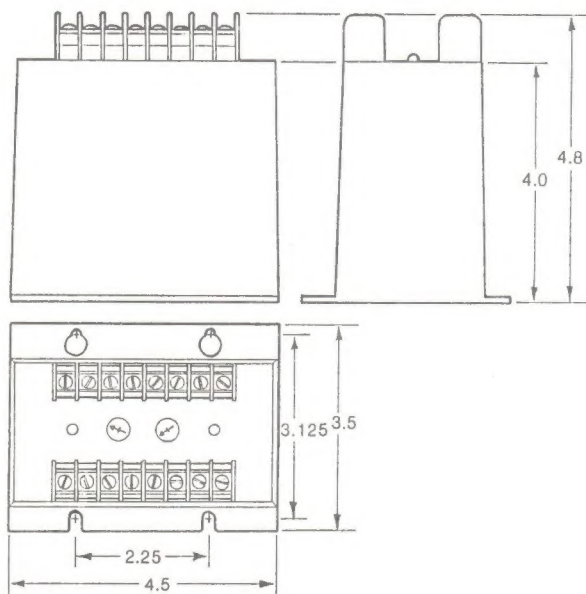
DESCRIPTION

The Model 2722 Current Unbalance Detector is designed to monitor 3-phase AC current (or three single-phase AC currents). A solid-state electronic sensing circuit drives an internal DPDT relay which is energized during normal, balanced conditions. An unbalanced condition will cause the relay to de-energize. The Model 2722 will accept current inputs up to 5 amperes, and will consider zero amps as balanced (relay stays energized), making the device suitable for use with 3-phase heaters. The Model 2722 has adjustments for percent of unbalance and time delay before tripping. The Model 2722 will automatically reset upon restoration of correct current balance, or a normally-closed momentary switch can be connected for a manual reset. External CT's can be used to extend the operating current range.

SPECIFICATIONS

Model No.	A2722	B2722	C2722
Supply voltage	20-28VAC	100-130 VAC	190-250VAC
Max voltage	30 VAC	140 VAC	260 VAC
Frequency range	50-400 z		
Power consumption	1.5W max		
Transient protection	2500VRMS for 10 ms		
Current range	1-5 amps		
Max current input	40 amps for 2 seconds		
Unbalance adjustment	2% tp 25%		
Trip delay	0.2 to 20 seconds, \pm 5%		
Output	DPDT relay		
Contact rating	480 VA at 120 VAC		
Operating temperature	0° to 55° C		
Humidity tolerance	0-97% w/o condensation		
Case material	ABS plastic		
Weight	1.35 lbs		

DIMENSIONS



IME MARK[®]
CORPORATION

11440 EAST PINE
TULSA OKLAHOMA 74116
(800) 862-2875
in OK (918) 438-1220

TITLE
DETECTOR,
CURRENT UNBALANCE

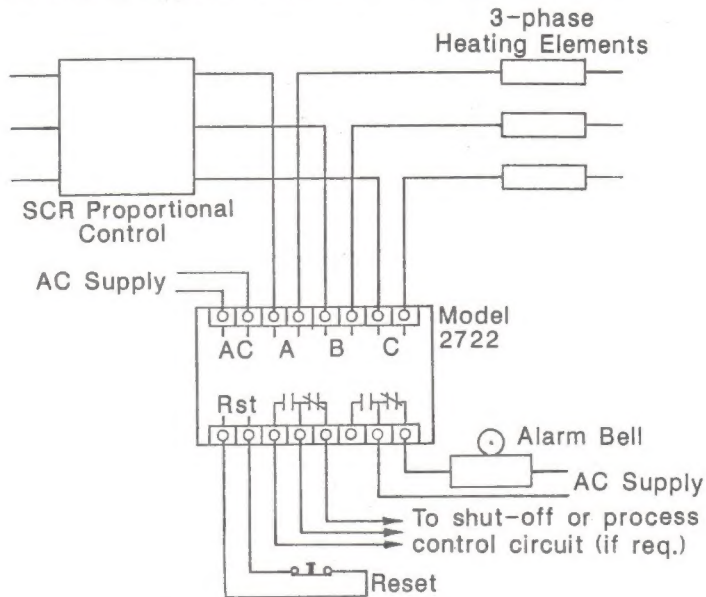
Dimensions are in inches unless
otherwise specified. Drawings show
no power applied.

© TIME MARK CORP. 1987

FORM NO. 87A 150 11/87

TYPICAL APPLICATIONS

Typical heater application, alarm with manual reset



Typical Motor control application, automatic reset

